Density control of carbon nanotubes for field emission by thermal chemical vapor deposition using diffusion layer

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The field emission property of carbon nanotubes reveals a strong dependence on the density and morphology of carbon nanotubes deposit. For optimal field emission characteristics, much effort has been made to control their growth. The growth of multiwalled carbon nanotubes were performed on amorphous silicon coated glass substrates by infrared radiation heated thermal chemical vapor deposition, using a gas mixture of carbon mono-oxide and hydrogen and Fe-Ni-Co alloy catalyst at temperatures as low as 480~580°C. We have controlled the growth of multiwalled carbon nanotubes in terms of the populations and diameters by introducing a buffer layer between catalytic layer and amorphous silicon coated substrates. The carbon nanotubs growth with the chemical vapor deposition technique might produce interaction of the metallic catalyst with silicon layer, which could interrupt the catalytic effect. The formation of silicide has been presented some letters and buffer layer was introduced to prevent this silicide. We will show how control of diffusion layer between the amorphous silicon and metal catalyst effectively control the formation of the silicide phase and consequently optimize the carbon nanotubes growth. This study will also discuss the related field emission properties.

We have deposited intermediate layer of 1 ㎚ to 20 ㎚-thick titanium, to be used as a buffer layer to control some reaction between catalyst and silicon layer. We have shown that such a barrier can be obtained by deposition thickness and thermal treatment. Figure 1 shows SEM image of the sample that was grown for 30 min on the 1nm Ti introduced between Fe-Ni-Co alloy and silicon layer. It was not found the carbon nanotubes. Figure 2 shows SEM image of the 20nm thick Ti buffer layer used at same growth condition and it was well grown. We will discuss the effect of buffer layer thickness and thermal treatment condition on silicide formation by diffusion and optimize the field emission property.

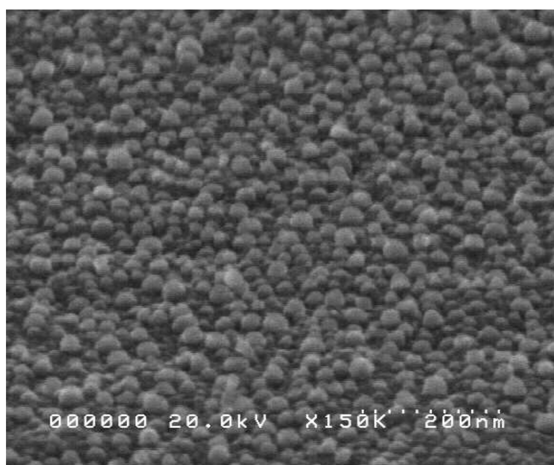

Figure 1. SEM image of that were grown for 30 min on the 5nm Fe-Ni-Co/1nm Ti/a-Si coated glass substrate.

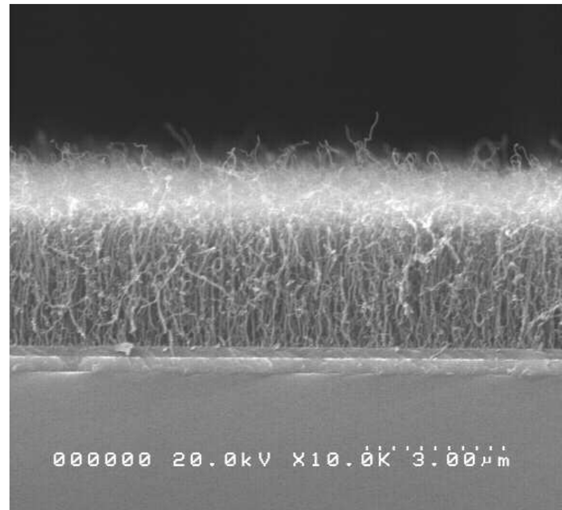

Figure 2. SEM image of that were grown for 30 min on the 20nm Fe-Ni-Co/10nm Ti/a-Si coated glass substrate.

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